

in Shark's Bay, Champion Bay, Geographe Bay, and King George's Sound; they collected on land, especially around Perth, Geraldton, and Albany, and travelled inland as far eastward as Kalgoorlie. They describe the south-western part of Australia as zoologically "a forgotten corner," for as Westralia is younger and larger and has a smaller population than the Eastern States, it has not been able to organise such extensive studies of its fauna and flora.

The authors regard their expedition as very successful, and their scientific results are to be issued in a series of volumes, of which the part now published is only the general introduction. It describes the authors' journey, and gives a list, with a map of their collecting stations. It consists of two reports, one by Prof. Michaelsen, describing his general observations on the geography of Westralia, including its scenery, physiography, flora and fauna, and the aborigines. Dr. Hartmeyer contributes an account of the sheep-farming, the mining industry at Kalgoorlie, and of the dredging expeditions. Both essays give a pleasant account of the country in spite of sufferings from the ubiquitous Worcester sauce. They gratefully acknowledge the ready help of the officials and people. They remark the "extravagant" width of the Kalgoorlie streets, and the difficulties of railway administration on lines where, as Prof. Michaelsen expresses it, there is no fear of collisions. Their Shark's Bay boatman seems to be a typical Australian; "he speaks not much, but he understands his business, and what he does he does with hand and foot." The report contains interesting comparisons with other faunas. Thus Prof. Michaelsen, who had previously studied the zoology of Lake Baikal, contrasts the fauna of that very ancient, perhaps pre-Devonian, deep lake, with the life of the recent, shallow pools of Western Australia.

The most generally interesting zoological result given is probably Prof. Michaelsen's conclusion as to the relations of eastern and western Australia as indicated by the earthworms (pp. 49-50). He holds that since the appearance of the ancient genus *Plutellus*, south-western Australia has been united by land only to the eastern States. There are no affinities to other lands, which are not also common to eastern Australia. Comparatively few foreign earthworms entered eastern Australia, and they arrived at different dates, and crossed subsequently into south-western Australia. There they developed into distinct though closely allied species, probably at a time when the land extended farther south-westward in separate peninsulas or had been temporarily divided into islands, which gave the worms on them complete though temporary isolation.

As the authors' journey was naturally confined to the best known areas in Westralia, there was not much opportunity for obtaining new geographical information, and the value of the work of the expedition will depend on the technical and biological memoirs which are to follow. This preliminary account gives evidence of such thorough and careful work, that important results may be expected from the work of two such skilled zoological experts.

J. W. G.

NO. 1986, VOL. 77]

OUR BOOK SHELF.

Experimental and Theoretical Applications of Thermodynamics to Chemistry. By Dr. Walther Nernst. Pp. x+123. (London: A. Constable and Co., Ltd., 1907.) Price 5s. net.

Technische Anwendungen der physikalischen Chemie. By Dr. Kurt Arndt. Pp. vii+304. (Berlin: Mayer and Müller, 1907.) Price 7 marks.

THE first of the above volumes contains a series of ten lectures delivered by Prof. Nernst at the Yale University in 1906 under the Silliman Foundation. After two introductory chapters, a *résumé* is given of the experimental investigations which have been carried out by the author and his students on chemical equilibria at high temperatures. In a theoretical discussion of the results, the author develops the view that relationships exist between chemical energy and heat other than those expressed by the first and second laws of thermodynamics. From a consideration of the conditions under which the principle of Berthelot comes nearest to expressing the true relation between heat and chemical energy, the conclusion is drawn that the total and free energies are not only exactly equal at absolute zero, but that their values coincide completely in the vicinity of this temperature. In the last three chapters the practical application of the integrated equation of the reaction isochore is illustrated by calculation of the equilibrium in various dissociating systems at high temperatures, such as water vapour, nitric oxide, hydrogen chloride, carbon dioxide, and metal ammonia compounds.

Whether the reader is interested in the fundamental theoretical speculations or the practical application of the derived formulæ, Prof. Nernst's series of lectures cannot be too warmly recommended.

In his "Technische Anwendungen" Dr. Arndt presents an account of certain chapters of physical chemistry and of recent investigations which have an important bearing upon technical processes. The volume does not make any pretence to be a complete treatise on the subject, but carefully chosen examples of the application of physico-chemical principles to industrial processes are discussed in considerable detail. In the first three chapters the formation of nitric oxide from air, the equilibrium in the manufacture of generator and water gas, the manufacture of sulphuric acid by the contact process, the formation of ammonia and of ozone are dealt with, the remaining ten chapters being devoted to a less detailed consideration of catalysts, changes of state, solutions, alloys, dissociation pressures, and the measurement of high temperatures.

The book is distinctly worthy of attention, has many good features, and contains a lot of useful references, although the author—if one may judge from the very small number of references to English chemical literature—does not appear to be very familiar with work carried out in this country. This is an unfortunate circumstance, and detracts not a little from the value of the book.

H. M. D.

Die Auszeichnungsrechnung nach der Methode der kleinsten Quadrate. By F. R. Helmert. Second edition. Pp. xviii+578. (Leipzig and Berlin: B. G. Teubner, 1907.) Price 16 marks.

THE principal changes in this new edition consist in the more detailed discussion of errors of observation, instrumental corrections, interpolation problems, and the reduction of triangulations. The last chapter deals with the choice of favourable conditions in various surveying problems. In its present form the work appears to be admirably suited for those who have to make practical use of the theory of errors, especially

surveyors and astronomers. The examples are mostly taken from actual observations, and the necessary calculations are given in considerable detail. In the earlier chapters a knowledge of determinants is not assumed, and the explanations given ought to make the method intelligible to readers of quite moderate mathematical ability. For the more difficult and controversial points of the theory, reference is made to the treatise of Czuber; at the same time, a very good example of the unavoidably empirical nature of the whole subject is given by working out the same elementary problem according to each of three different laws of error. Now that the measurements of physics and chemistry are approaching, not to say surpassing, in exactness those of astronomy and geodesy, a practical work of this kind is likely to assist a larger and larger body of experimenters.

Die Purpurbakterien. Eine mikrobiologische Studie. By Prof. Hans Molisch. Pp. 92. (Jena: Gustav Fischer, 1907.) Price 5 marks.

THIS memoir deals with an interesting group of chromogenic microorganisms, viz. those producing brilliant pigments ranging in tint from pink, through rose and deep red to reddish-purple. They are probably more nearly allied to the coloured algae (Phycchromaceæ) than to the bacteria proper, and one of the earliest descriptions of a member of the group was given by Sir Ray Lankester in 1873 under the title of a "peach-coloured bacterium." The author first discusses the occurrence in nature of these organisms. Sometimes they are met with in great abundance on the sea-coast, in river estuaries, and in hot and sulphur springs. Directions are given for obtaining growths in various organic mixtures, for the preparation of suitable culture media, and for obtaining pure cultures in the latter. The biological and physiological properties are next considered; while light has an inhibitory, or a germicidal, action on most bacteria, the "purple" bacteria develop best in its presence. They are sensitive to all light rays, but in particular to the ultra-violet ones; they do not, however, evolve oxygen in the presence of light, and their need for oxygen varies much, some species being almost anaërobic.

The colouring matter produced by the "purple" bacteria is a mixture of two pigments—a green, "bacteriochlorin," and a red, "bacteriopurpurin." The chemical and other properties of these are described fully.

As regards classification, the organisms are grouped in a special order, the Rhodobacteria. This is divided into two families, distinguished by the presence or absence of sulphur granules, and several new species isolated by the author are described. Altogether the book forms a very useful summary of our knowledge of an interesting and peculiar group of microorganisms.

R. T. HEWLETT.

The Case of Existence. By Norman Alliston. Pp. xiii+262. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1907.) Price 5s. net.

"Of the enigmas of life," says Mr. Alliston in his introduction, "all speak; but nobody acts as if there were an enigma." It is his object to remove this inconsistency by exposing the confusions of thought of those who "want life speculatively to be a mystery." The book has three parts. The first contains a good account of the nature of Explanation and some not ineffective criticisms of Knowledge, Nature, &c., mingled, it must be admitted, with much rather ill-informed dogmatism. The second, in the course of a review of man's "obstinate questionings" about existence, develops the author's peculiar egoistic optimism. The third, in which he draws his ethical

corollaries, unfortunately contains some chapters which many readers will find offensive both in matter and in tone. The book contains little to engage the attention of the practised student of philosophy, but, being written with obvious conviction and enthusiasm, may here and there attract a useful recruit to the study of first principles. At a later stage the student may not unprofitably return to these pages to detect and analyse the crudities and ambiguities which abound under a surface of apparent lucidity.

Science German Course. By C. W. P. Moffatt. Pp. xii+228. (London: W. B. Clive.) Price 3s. 6d.

THE portion of this book devoted to grammatical construction and word formation occupies about eighty pages, and is followed by extracts for translation from the German. These selections deal with various scientific subjects, and can be commenced after the student has made himself familiar with the first few pages of the grammar that precedes them. Short vocabularies are given of technical terms in mathematics, physics, chemistry, geology, botany, and zoology. The book thus provides a convenient means of obtaining sufficient acquaintance with the German language to read simple scientific descriptions in it with intelligence.

LETTERS TO THE EDITOR.

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The Wehnelt Kathode in a High Vacuum.

THAT a good vacuum can be made into a good conductor by the use of an incandescent kathode is known since the discovery of the Edison effect, and has been investigated with great thoroughness by O. W. Richardson (Trans. Roy. Soc., 1903, 201A, 497). Wehnelt has shown (*Ann. d. Physik*, 1904, iv., 14, 425) that if the incandescent kathode is coated with one of the alkaline earths, surprising results can be obtained. From a platinum foil kathode at 1300° C. to 1400° C. coated with lime, two to three amperes per sq. cm. of surface can be passed through a good vacuum, the kathode fall being practically negligible, and the total voltage across the vacuum tube being below 30 volts. This result is so very remarkable that I have repeated it in the following way to test whether, as is commonly supposed, the phenomenon is really independent of the perfection of the vacuum.

In a tube provided with a Wehnelt kathode of about a sq. cm. area was mounted an anode of the metal calcium. I have recently shown (Proc. Roy. Soc., 1907, 78A, 429) that calcium at its volatilising temperature (700° C. to 800° C.) absorbs practically instantaneously and very perfectly all known gases and vapours except the chemically inert gases of the argon family, and have described a form of vacuum furnace suitable for this operation. The tube was prepared in the usual way by preliminary exhaustion and washing out with oxygen to remove argon, and then subjected to the action of calcium heated in a furnace attached to the apparatus. When a good vacuum had been obtained, current from the 250-volt supply was passed through the tube between the heated Wehnelt kathode and the calcium anode in order to heat the latter.

The gases evolved from the anode and tube under this treatment were absorbed by the calcium in the furnace. The current was regulated by a resistance to about 1.2 amperes, and was interrupted at intervals to give the evolved gases time to flow out of the apparatus. When the gases had been for the most part removed the current was passed continuously, heating the calcium anode up to its volatilising point. Quite suddenly and completely the current through the tube stopped, and at the same moment a copious mirror of calcium was volatilised from the anode. In a little while a very feeble glow started and passed